FRENCH REPUBLIC

MINISTRY OF INDUSTRY

INDUSTRIAL PROPERTY SERVICE

PATENT

Report No. 873,382 **No. 1,418.757**

International Classification: **B01 f**

Novel Agitation Device (Invention: Robert DAUBY)

INSTITUT FRANÇAIS DU PÉTROLE, DES CARBURANTS ET LUBRIFIANTS resident in France (Seine-et-Oise)

Application Filed on September 14th, 1961, at 7:00 p.m., by post.

Granted on October 18th, 1965

(*Official Industrial Property Bulletin No. 48 of 1965*)

(*Patent granted by virtue of article 11, § 7, of the law of July 5th, 1844, as amended by the law of April 7th, 1902.*)

Numerous industrial operations require the use of agitation devices, particularly when liquids must be brought into close contact with, or mixed with, solids, gasses or other liquids. Nonetheless, most of these devices are not suitable when good hermetic sealing of the apparatus is required, particularly when this must operate under a pressure which is less than or greater than atmospheric pressure, or in a gaseous atmosphere other than air.

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Ref. #127
SMX 3099.1 (98-14CIP1)
Dales, et al.
09/177,170

The problem is yet more difficult to overcome when small-sized apparatus is used, particularly laboratory apparatus.

Conventional agitators, known as "mercury seal" agitators, do not allow for operation at pressures other than atmospheric pressure, without using excessively high mercury columns. Similarly, "turning joint" or "stuffing-box" agitators not only consume a considerable amount of energy and overheat, but they are insufficiently hermetic and require semi-continuous lubrication, without which they jam. Furthermore, when apparatus equipped with such agitators are run under vacuum, it is difficult to avoid some of the lubricant being suctioned and contaminating the phases to be mixed.

As for built-in rotor agitators, these require the use of special and expensive electric motors, which greatly overheat and require cooling.

Lastly, magnetic agitators, which comprise a simple metal bar, which is submersed in the liquid and driven by a rotating magnetic field, which is induced from the exterior of the container in which the liquid is contained, are not only suitable solely for very small apparatus, but cannot be used with thick-walled containers, particularly where a heating or cooling fluid circulates around the apparatus.

Unlike the aforementioned apparatus, the agitation device according to the invention allows for efficient agitation of any volume of liquid, in the presence or absence of solids, gasses or other liquids, with minimum energy consumption, without substantial overheating, even at pressures other than atmospheric pressure, and in containers of any shape or thickness. With this low-cost device, there is no risk of contamination by lubricants.

This device essentially comprises a combination of: an axle mounted in free rotation in a fixed support; agitation surfaces rigidly attached to the axle, located on the same side as the axle with respect to the support; at least one magnetizable member provided at the opposite extremity of the axle with respect to the agitation surfaces and in a plane substantially perpendicular to this [axle]; a casing surrounding said metallic member, rigidly attached to the axle support and capable of being fixed in a substantially hermetic manner on the container in which the medium to be agitated is located; rotating field magnetization means located in the vicinity of the magnetizable member but separated therefrom by a portion of the casing, wherein at least this portion of the casing is preferably formed from an electrically insulating material. For example, the rotating electrical field can be created by a second magnetizable member, provided in a plane parallel to the first member, and capable of rotating on a axis which is substantially an extension of the first axis, wherein at least one of the magnetizable

members is magnetized so that they cause each other to move. The field can also be an electromagnetic field created, for example, by a rotating electric coil, or by a collection of electric coils mounted perpendicularly to the axis of the agitator and oriented differently from each other, wherein an electrical current passes though these coils successively.

FIG. 1 shows one example of a particularly simple mode of embodiment of this device.

An axle 1 is supported by a bearing 2 and can rotate freely around itself. At the lower extremity thereof, it is provided with blades 3 which are intended to stir the liquid contained in a container 4, while at the upper extremity thereof, it is provided with a steel bar 5. The bearing 2 is rigidly attached to a casing 6 which is fitted into the neck of a flask 4. A chuck 14, which may or may not be used, allows the upper part of the rod to be separated from the lower part thereof, if necessary.

A magnetized bar 7 is connected to an axle 8, which is driven by any sort of motor, or even by hand. The rotation of the bar 7 in a plane perpendicular to that of FIG. 1 causes the bar 5, and therefore the axle 1 and the blades 3, to rotate, which in its turn results in mixing of the liquid contained in the container 4.

It is expected that any material can be used to produce the device according to the invention, with the exception of the magnetizable members 5 and 7, which must be at least partially composed of ferromagnetic material, such as iron, nickel, cobalt, or magnetite, at least one of these being permanently magnetized. It is, however, preferable that the portion of the casing located between the members 5 and 7 be composed of an insulating material so as to avoid any heating and energy loss due to Foucault currents.

The support 2 of the axle 1 can be of any sort, such as a low friction [bearing], but it is advantageous to use a ball bearing or a needle bearing, which can, where appropriate, be formed of stainless steel. Whether or not the bearing is hermetic is of no consequence, as the hermetic seal is provided by the casing, which allows for the use of non-hermetic reduced friction bearings which could not be used in conventional devices. It is also possible to use multiple supports along the axle 1, similar to the support 2, which has the advantage of stabilization.

The junction between the casing 6 and the container 4 can be of any sort, so long as it is hermetic. A seating can be used, as shown in FIG. 1, as can a flange or collar.

It is not necessary that the magnetizable parts of the device have the shape of a bar, as shown in FIG. 1. Other devices can equally well be used, such as, for example, a magnetized ring, comprised of a series of opposing poles, wherein this ring

is supported by axle 1 and/or 8. A variation on the device described above is one wherein the casing of the apparatus is provided with a gas, liquid or solids introduction or extraction opening, wherein this opening can, for example, be used to create a vacuum in the apparatus.

An improvement on the device described above is shown in FIG. 2, and consists of producing the device according to the invention in several parts which are suited to each other, which allows for easy replacement of certain parts, and for easier cleaning of the apparatus.

In this case, the casing comprises a cover 9 which can be screwed onto a cone 10, and these two parts are, for example, formed from a transparent material such as methyl polymethacrylate, known under the trademark of Plexiglas. The cone 10 is in turn screwed onto a member 11, which is preferably metallic, and which supports an axle 12 by way of a ring 16 and includes a ball bearing 13. This axle ends in a chuck 14 which can accommodate the shaft of a typical agitator 15. The bar 5, which is rigidly attached to the axle 12, is driven by means of the bar 7, supported by the shaft 8, as in the example illustrated by FIG. 1.

SUMMARY
[CLAIMS]

The present invention relates to:

1. A novel agitation device essentially comprising a combination of: an axle which can rotate around itself; agitation surfaces rigidly attached to the axle, located in the vicinity of one of the extremities of this [axle]; at least one magnetizable member substantially located at the opposite extremity of said axle, with respect to the agitation surfaces, and in a plane substantially perpendicular thereto; a casing surrounding said metallic member and a portion of the axle, said casing serving to support the axle, and being capable of being joined in a substantially hermetic manner to a container containing a material to be agitated; and rotating field magnetization means, provided in the vicinity of the metallic member, but separated therefrom by a portion of the casing.

2. A device according to [claim] 1 wherein at least the portion of the casing located between the rotating field generation means and the magnetizable member is composed of an electrically insulating material.

3. A device according to [claims] 1 and 2 wherein the magnetizing means comprise a magnetic field created by a permanent magnet or an electromagnetic filed, and wherein the magnetizable member is or is not magnetized.

4. A device according to [claims] 1 and 2 wherein the magnetizing means outside the casing comprise a non-magnetized magnetizable member, and wherein the magnetizable member contained within the casing is a permanent magnet.

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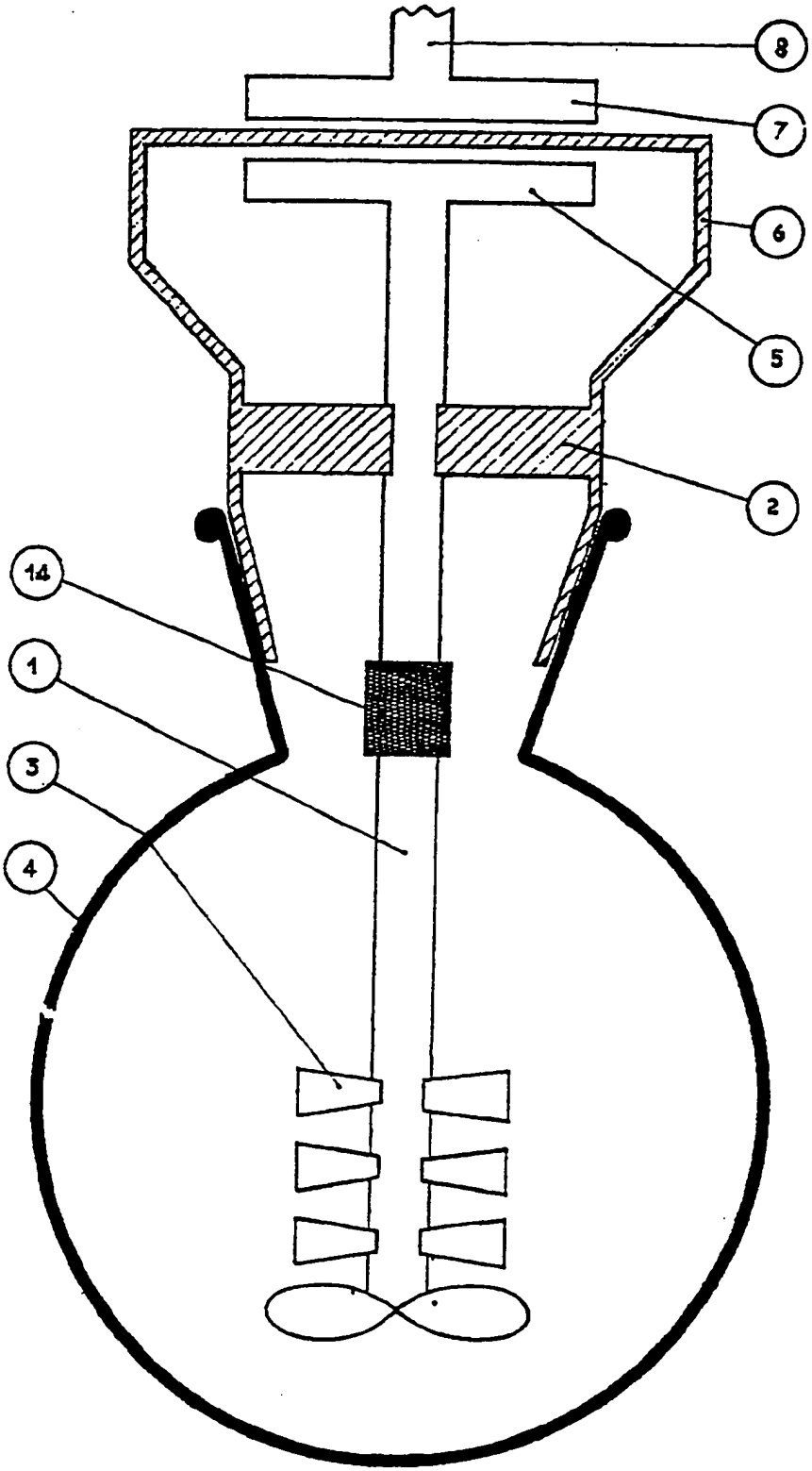

Fig.1.

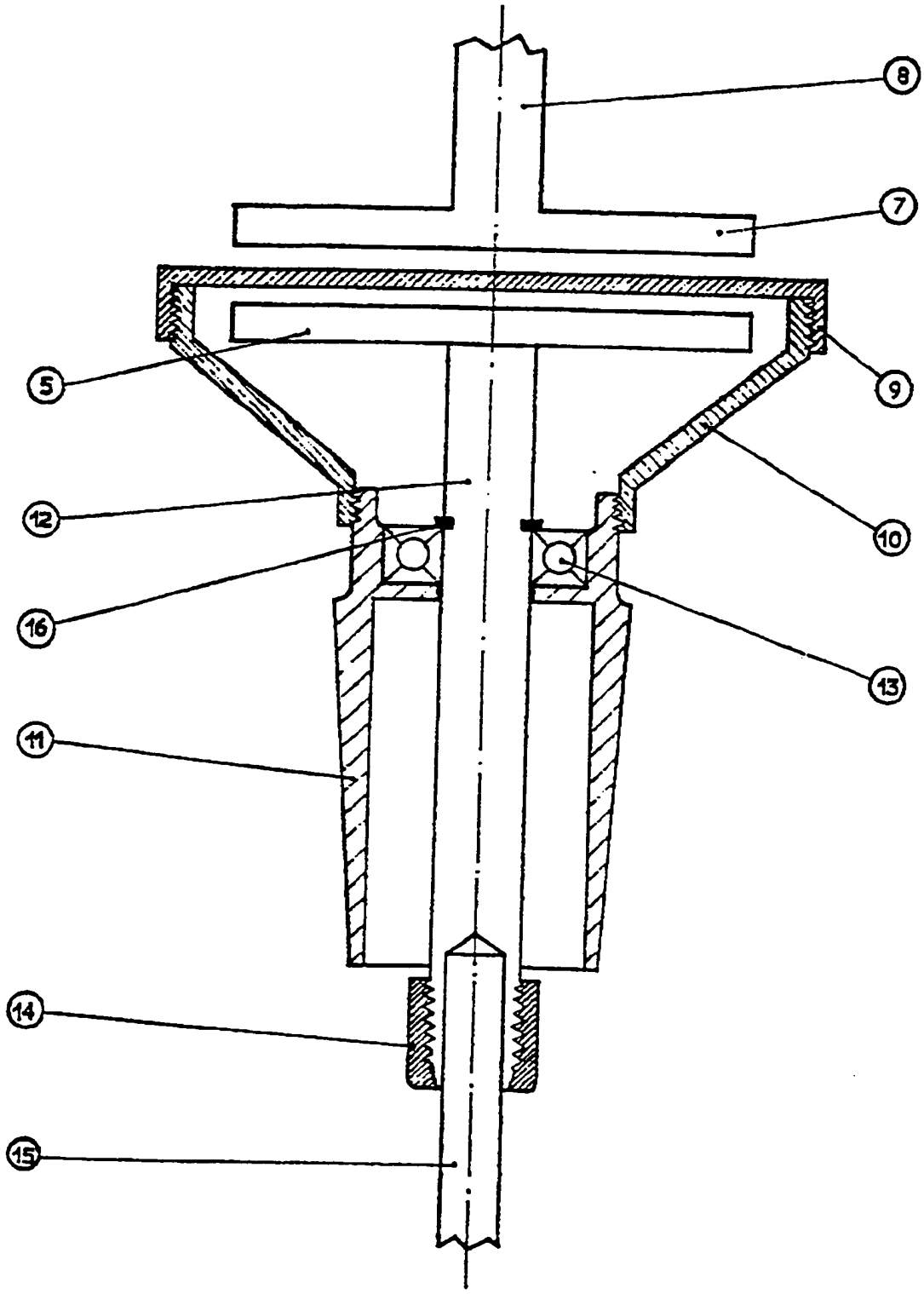

Fig.2.